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Fall 2021

## FED 101-L53: Fundamentals of Engineering Design

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## Fundamentals of Engineering Design

FED 101

2 credits

Class meetings: FED 101-L53 Monday      8:30 am -11:20 am  
FED 101-007 Wednesday      8:30 am -11:20 am

Room 411 Tiernan Hall (Computer Lab)\Room 206 Tiernan Hall (FED Lab)

**Instructor: Dr. Irina Molodetsky**

Room 350 Tiernan Hall

Office hours: Wednesday, 1-5:00pm;

**Please, contact by email for additional meeting**

Email: [Irina.Molodetsky@njit.edu](mailto:Irina.Molodetsky@njit.edu)

**FED 101 is an introduction to a chemical engineering process design. The course combines engineering science and elements of the engineering design cycle that the teams of students use to build a laboratory model of a mini-plant prototype.**

**At the end of this course, the successful students will:**

- Know main steps of the engineering design
- Design and build a scale-down lab prototype of a mini-plant
- Know relationship between the flowrates and average flow velocity
- Measure flowrates and static pressure in the flow systems
- Know relationship between energy and pressure in the fluid
- Manipulate different units of pressure and flowrates
- Predict and measure pressure drops in the flow system
- Analyze and present experimental data
- Work in a team of peers, assess and improve collaborative environment

**Details about assignments and grading policies are discussed in the “Introduction” lecture.**

**If you need accommodations due to a disability please contact Chantonette Lyles, Associate Director of Disability Support Services, Fenster Hall Room 260 to discuss your specific needs. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.**

## Course Schedule

W1	<p>Course Introduction. Schedule and grading policy</p> <p>Engineering Design Cycle: problem identification</p> <p>Engineering Science:</p> <ul style="list-style-type: none"> <li>• Average fluid velocity, <math>\bar{v}</math></li> <li>• Volumetric flow rate, Q</li> <li>• Mass flow rate, <math>\dot{m}</math></li> </ul> <p><b>Instruments and engineering measurements</b></p> <ul style="list-style-type: none"> <li>• Flowmeters</li> </ul> <p><b>Design of the experiment</b></p> <ul style="list-style-type: none"> <li>• Flowmeter Calibration</li> </ul> <p>FED Laboratory orientation</p>
	<p><a href="#">10 minutes quiz #1</a></p>
W2	<p>Data analysis</p> <ul style="list-style-type: none"> <li>• Working with Excel.</li> <li>• Statistical errors. Accuracy. Precision.</li> <li>• Making graphs in Excel</li> </ul> <p><b>Lab:</b> Construction and measurements</p> <p><a href="#">Manual for the lab experiment and Template for the Lab report are uploaded.</a></p>
	<p><a href="#">10 minutes quiz #2</a></p>
W3	<p><b>Units and Units Conversion</b></p> <ul style="list-style-type: none"> <li>• Primary units, SI, English. Dimension units</li> </ul> <p><b>Concepts</b></p> <ul style="list-style-type: none"> <li>• Pressure. Hydrostatic pressure</li> </ul> <p><b>Instruments and engineering measurements</b></p> <ul style="list-style-type: none"> <li>• How to measure static pressure in the fluid</li> <li>• Bourdon gauge. Absolute pressure and gauge pressure</li> </ul> <p><a href="#">Lab: Completion of “Flowmeter calibration”</a></p>

	10 minutes quiz #3
W4	<b>Concepts</b> <ul style="list-style-type: none"> <li>Pressure-Energy relationship</li> </ul> <b>Instruments and engineering measurements</b> <ul style="list-style-type: none"> <li>Centrifugal pump</li> </ul> <p>Design of Experiment: Exploration of Pressure drops in a flow system</p> <p><b>Lab:</b> Construction and measurements</p> <p><b>Manual for the lab experiment and Template for the Lab report are uploaded.</b></p>

	10 minutes quiz #4
W5	<b>Exercises and problems solving</b> Estimates and Analogy <b>Lab:</b> Exploration of Pressure drops in a flow system (“Pressure Drops”)

	10 minutes quiz #6
W6	<b>Concepts</b> <ul style="list-style-type: none"> <li>Single flow through a packed column</li> <li>Laminar and turbulent flows.</li> </ul> <b>Modeling</b> <ul style="list-style-type: none"> <li><b>Ergun equation: pressure drop</b> calculations (discussion of parameters: effective particle size; void fraction, surface area, <math>g_c</math> conversion factor)</li> </ul> <p><b>Lab: Completion: “Pressure Drops”</b></p>

	10 minutes quiz #7
	<b>Exercises and problems solving.</b>
W7	Estimates and Analogy
	<b>Lab demo: Packed Column</b>

	TEST
W8	<p>Discussion of the <b>application</b> of spray column and packed columns</p> <p><b>Final design: discussion of requirements</b>  Requirements for final design are uploaded.  Work on the final design (Visio)</p>

	10 minutes quiz #7
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W9	Test –lessons learned  <b>Modeling</b> <ul style="list-style-type: none"> <li>• Ergun equation</li> </ul> <b>Lab:</b> construction
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	10 minutes quiz #8
W10	<b>Lab:</b> construction and measurements.

	10 minutes quiz #9
W11	<b>Concepts</b> <ul style="list-style-type: none"> <li>• Ergun equation –Viscosity (dynamic and kinematic)</li> <li>• Demo (class)</li> </ul> <b>Lab:</b> construction and measurements Requirements for final presentation -uploaded

	10 minutes quiz #10
W12	Work on electronic design notebook Work on final presentation

W13	Review Lecture “300-500 words” assignment  Meeting with individual teams to give a feedback for submitted ppt slides; <b>Final report “Pressure Drop measurements” is due</b> <b>Peers evaluation form is due</b>
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W14	Prep for Final demo and ppt presentations (see final exam schedule)
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**Grading** (changes may apply)

A	90 and above
B+	85 and above
B	80 and above
C+	70 and above
C	60 and above
D	50 and above
F	below 50